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N. A. C. A. BULLETIN

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IN TWO SECTIONS

Section I

N.A.C.A. LIBRARY

IN THIS ISSUE

Production and Inventory Control, by Sydney W. Warner..... 43

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EDITORIAL DEPARTMENT NOTE

To have material on hand as needed in a company doing a "glorified job order" business, where there are approximately 800 models and in the neighborhood of 4,000 different specifications for a single major product line, provides a problem in production planning and control of great difficulty. How this problem has been solved in the Timken-Detroit Axle Co. is the subject of the article in this issue of the *Bulletin*. Production planning and control is a subject of great interest to industrial accountants because of its close interrelation with inventory control and the reduction of costs. To so plan and control production in a company manufacturing to customer's orders that material will be received as needed, eliminates the necessity for large investments in raw materials and the cost of storage and reissue. While the conditions found in this company probably are not usual, readers will undoubtedly find much of interest and value in this article.

Sydney W. Warner, the author of this article, is Secretary and Controller of The Timken-Detroit Axle Co. He is a Certified Public Accountant of Wisconsin and Michigan and an associate member of the American Institute of Accountants. For fifteen years before joining The Timken-Detroit Axle Co., Mr. Warner was associated with the public accounting firm of Ernst & Ernst.

Articles published in the *Bulletin* present many different viewpoints. In publishing them the Association is not sponsoring the views expressed, but is endeavoring to provide for its members material which will be helpful and stimulating. Constructive comments are welcomed and will be published in the Forum Section of the *Bulletin*.

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SEPTEMBER 15, 1940

PRODUCTION AND INVENTORY CONTROL

By Sydney W. Warner, Secretary and Controller, The Timken-Detroit Axle Co., Detroit, Mich.

PERHAPS the best way to introduce the production and inventory control methods of our company is by giving you a brief picture of our business and some of the problems with which we have to contend, and to let you see some specimens of the more important forms we use in our production and material departments.

From the outset, we do not want to take the position that our methods are beyond improvement or necessarily reflect the latest word in controlling production and inventories. Rather, we prefer to consider this as a case discussion of how we go about handling these problems in our business. You have often heard the remark, "Our business is different from anybody else's" and, while we feel that the fundamental principles of any system of production and inventory control are basically the same in any business, nevertheless, we have had occasion during the past several years to have a number of surveys made of our production and inventory control system and thus far we have found no one who has been able to suggest any real improvement in the methods we are using.

Products

In order that you will have the general picture of our business, we might say at this time that the principal products of our Detroit plants are front and rear axles for trucks, buses, trolley coaches, tractors and trailers, and four- and six-wheel drive units for specialized commercial automotive equipment. Our business also embraces other activities such as the manufacture of transmissions and axles for farm tractors, brakes, forgings, a complete line of wall flame and pressure type oil burners, oil-fired air conditioning units for homes and small commercial buildings, oil burner water heaters and a complete line of power tools for working in wood or metal, such as drill presses, band saws, circular saws, jointers, shapers, grinders, sanders, lathes and similar machines.

I will confine myself here to that part of our business which deals with the manufacture of axles. We have been in the automotive

axle business since the infancy of the automobile industry. For some time we manufactured axles for passenger cars as well as commercial trucks, etc. In recent years we have found it advisable to confine the largest portion of our axle business to equipment suitable for trucks and commercial vehicles rather than passenger car type axles.

Variety of Models and Specifications

Fifteen or twenty years ago we did not have the problems in the manufacture of axles that we have today. At that time we manufactured probably a dozen standard model types of axles, which met all of our customers' requirements at that time. Today the situation is entirely different. We have approximately 800 models of axles which can be built up to approximately 4,000 different specifications. The explanation of this is quite simple when you consider the tremendous strides that have been made in the commercial truck and passenger car industry during the last two decades. Manufacturers of vehicles requiring our axles today have reached a highly specialized state. While it is true that there are certain standard types of automotive truck vehicles such as half ton, one ton, ton and a half, two ton and five ton trucks for regular hauling service, there are also countless numbers of vehicles which are being built today for specialized projects which require axles of special design to meet the peculiar conditions these vehicles encounter in actual operation. The laws in various states require different types of axles to meet varying road specifications, etc.

Our axles are used in practically every form of transportation and in many types of military vehicles such as gun carriages, army tanks, army trucks, etc. Our axles have been quite prominent in the mechanization of the armed forces of this country as well as foreign countries, all of which has required constant planning on the part of our engineering and development departments to meet the axle requirements of any particular type of vehicle developed in the industry today.

Parts Requirements

To manufacture the range of various types of axles required, it is necessary for us to carry approximately 35,000 different parts. When called upon to handle such a large number of parts it is

quite apparent that more than mere guess work is necessary to provide the required materials in the manufacture of our product. The demands of our customers require that we be equipped to build one axle as efficiently as 1,000. Generally speaking, our problems are those of a "glorified job shop" as distinguished from a straight-line production shop such as you will find in the passenger car industry today.

If we were called upon to build only fifteen or twenty types of axles during the year, our problem would be comparatively simple, but where we must be in a position to supply any one of approximately 800 different types of axles built to any one of a possible 4,000 specifications, it is not difficult to visualize the problem with which we are confronted in inventory and production control. With this brief outline of our business we will attempt to give you a picture of some of the more important things we do and the records we use in controlling inventories and production.

The Bill of Material

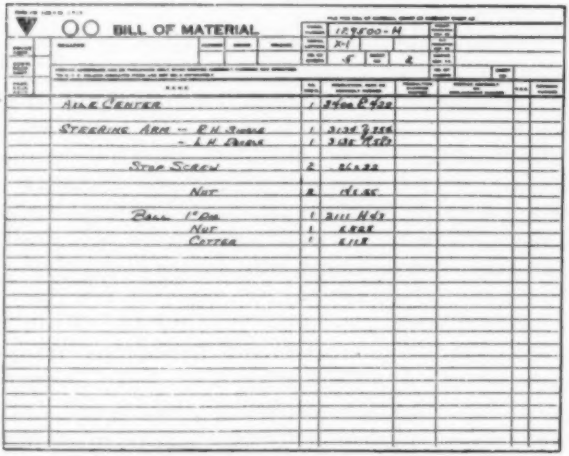
When we receive an order from a customer our first step, as is common practice in all businesses, is to determine the financial responsibility of the customer. If this is satisfactory we go about planning the necessary steps to be taken to manufacture the axle.

After a customer's order is received by our sales department, it is first sent to our specification department where it is checked for specifications to determine if it is similar to some other axle we have previously produced. If the order calls for an axle corresponding to one that we have made in the past, no particular problem is created as we already have available complete bills of material for that type of axle. However, where the axle differs, regardless of how slightly, from any axle we have previously manufactured, a new bill of material must be made. This bill of material may be prepared in detail if it is an entirely new axle or it may, in the case of only minor changes, cite another similar axle listing the necessary additions or eliminations or combinations of both from that axle.

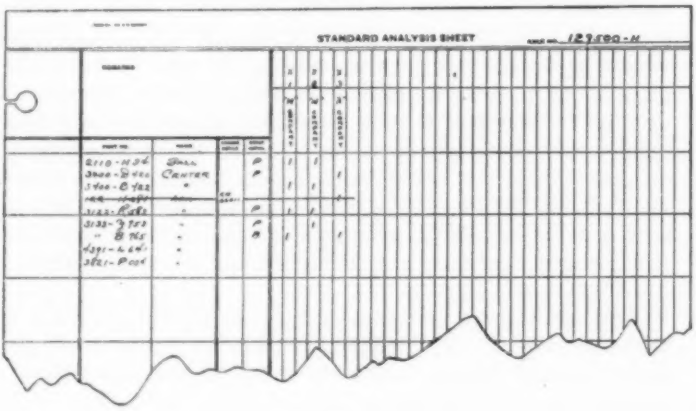
A specimen of our permanent bill of material, Form No. 498, is shown on page 46. The original of this bill of material is made up on tracing cloth on which the details of the parts, sub-assemblies, etc., are written in in ink. Prints are run from the

original bill of material for distribution to the cost department, material department, standards department, tool design, assembly floors, and possibly others.

BILL OF MATERIAL
FORM 498



STANDARD ANALYSIS SHEET
FORM 613



Uses of Bill of Material

The cost department uses their copy of the bill of material in making estimates and in arriving at cost figures, which will later become our standards. Perhaps one step which we should have mentioned earlier is that frequently our sales department is called upon to quote on special axles which require preliminary bills of material to enable our cost department to determine estimated costs to be used in establishing the sales price that has to be quoted.

The copy of the bill of material furnished to the standards department and the copy furnished to the shop and assembly floors are used to plan the scheduling of material through the shop and for estimating or determining the labor cost for machining, assembling, etc., in connection therewith.

The copy furnished to the tool design department is used by that department to determine whether we have available the necessary tools or whether new tools will be required to machine the parts listed on the bill of material, and to plan so that these tools will be available at the time they are required.

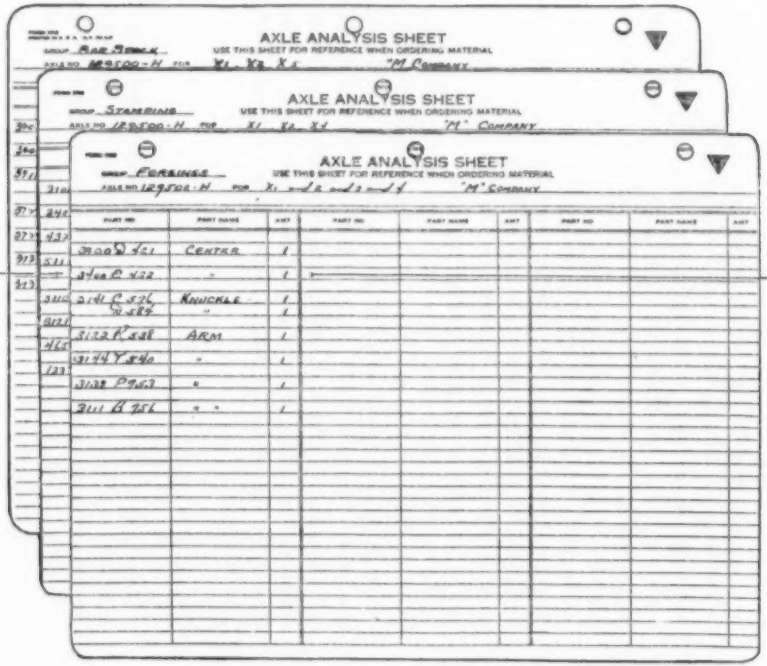
The material department uses their copy of the bill of material to check their records in order to determine whether they have available the individual material parts required in the various subassemblies that go to make up the complete product covered by the bill of material. This is done by listing the various individual material parts that are required and breaking down the various subassemblies shown on the bill of material into individual material part numbers.

Standard Analysis Sheets

The vehicle used by our material department for this purpose is Form No. 613, "Standard Analysis Sheet." If you will refer to this standard analysis sheet, you will note that on the left hand side of the sheet space is provided for listing each of the parts required by number and name. The columns appearing on the right hand side of the sheet have been prepared to take care of 32 different specifications of the type of axle shown in the upper right hand corner after "Axle Number." The reason for this is that each customer has his own special requirements on certain parts which they specify on an axle.

AXLE ANALYSIS SHEET

FORM 1006



We have in our material department, standard analysis sheets for all of the various types of axles which we manufacture. These, in reality, are nothing more than a listing of the material parts shown on the bills of material. Some of the various types of axles have as many as one hundred different specifications to which they may be built.

The Axle Analysis Sheet

To further follow the usage of these standard analysis sheets, we might say at this time that our material department in general functions along the following lines: Due to the large number of parts which we have to provide for, our material department is divided into various groups such as the malleable group, forging group, stamping and worm gear group, bar stock and tubing parts group, gear and pinion group, etc. When the standard analysis sheet, previously referred to, has been prepared it is passed around to the various groups in the material department and each group then prepares what is known as Form 1006, "Axle Analysis Sheet," and initials the standard analysis sheet in the space provided under "Group Initial" to indicate that each part listed on the standard analysis sheet has been given consideration.

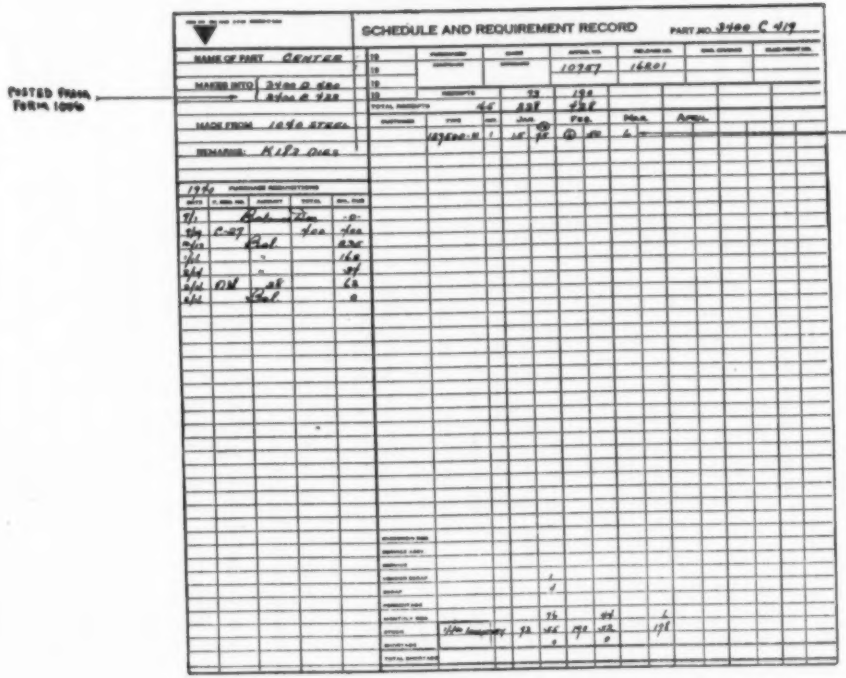
If you will refer for a moment to the specimen of Form 1006, axle analysis sheet, you will note that this form merely serves the purpose of listing the material parts to be furnished by that particular group for the axle required. After this form has been prepared, each group in the material department then places this information on what is known as Form 242, "Schedule and Requirement Record."

The Schedule and Requirement Record

Referring to this form, you will note that in the upper left hand corner the name of the part, what it makes and what it is made from is shown. On the upper right hand side of the form space is provided to show the service usage requirements for the last four years and whether it is purchased on the outside or made in our plant. If it is made in our plant, the appropriation number, release number, engineering change number and blue print number are indicated. Each part number is considered separately and the maximum and minimum inventory that should be required on this

SCHEDULE AND REQUIREMENT RECORD

FORM 242



particular part is also shown. The placing of a minimum and maximum figure not only assists us in purchasing and in anticipating shortages but also materially helps in controlling the investment we are carrying in these parts.

Going back to the left hand side of this schedule and requirement record again, you will note that space has been provided to show that a purchase requisition has been sent to the purchasing department and to keep a record of the status of these requisitions. The right hand side of the card shows columns headed "Customer," "Type" and "Amount," which are used to indicate the name of customer, type of axle and quantity required of this particular part on each axle. Space is also provided for listing the monthly accumulative receipts. The blank columns on the right hand side of the form are used to show the requirements for each month. These columns are headed to indicate the various months throughout the year, showing the number required each month. If, for example, four hundred parts are required for a certain type of axle in January and for some reason or another it is decided that these axles cannot be built until February, a red figure of four hundred would appear in the January column and a black figure four hundred would be posted in the February column, indicating that, while the part had been originally scheduled for January, it has been taken from the January schedule and placed on the February schedule.

At the lower center of the form you will find space has been provided for keeping "Monthly Requirements," "Stock" and "shortages." Whenever a new card is started the inventory on hand is indicated in the space provided for "Stock" and a running record is then kept of the stock on hand by adding the monthly receipts for parts manufactured and deducting the monthly requirements or usage. Projecting the requirements ahead several months also indicates monthly shortages which will have to be provided for.

Stock Location and Perpetual Inventory Records

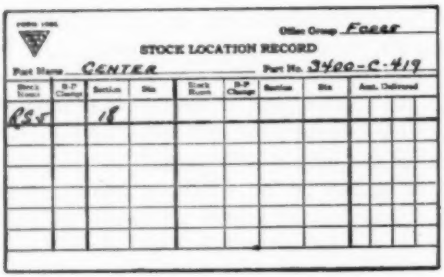
We have various stock rooms located throughout the plant and the "Stock Location Record," Form No. 1002, is kept in the material department to determine the location of any particular part, sub-assembly or finished assembly we might have. If you will

refer to this record you will note that it shows the part number, part name and location of the stock room and bin in which the part is stored. On the reverse side of the card, space has been provided to keep a running record of the service requirements, which is the method we use for determining the service requirements indicated on Form No. 242, schedule and requirement record, previously discussed. This stock location record is filed by part number.

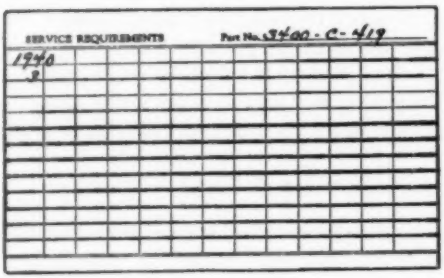
STOCK LOCATION RECORD

FORM 1002

(FRONT)



(REVERSE)



In each of the stock rooms throughout the plant a perpetual material inventory record is kept on Form 174, "Productive Storage

PERPETUAL INVENTORY RECORD
FORM 174

Form 174
PRODUCTIVE STORES RECORD
STOCK ROOM R.R.S. PART NO. 3400 C419
PART NAME AXLE CENTER
SECTION CRANE
BIN
KEPT IN STOCK ROOM

DATE	FROM	TO	REC'D	DEL'D	BALANCE
INVENTORY			7/1/39		44
7/13		56		30	14
7/27		56		14	0
11/30	86		35		35
12/8	86		130		165
		56		130	35
12/19		56		35	0
1940					
1/6	86		73		73
–		56		73	0
1/10	53		1		1
–		86		1	0
2/17	86		128		128
3/29	86		62		190
3/6		56		25	165

(OVER)

Record." This record indicates the material on hand and in which bin it is located. We might add here that periodically physical counts are made throughout the year to check the accuracy of these records. Our general plan is to make physical test checks of the quantities in all of the bins at least once a year. A record is made and attached to each bin showing the date on which the last physical count was made and a report is given to the management

AXLE AUTHORIZATION
FORM 425

POSTED FROM FORM 242

Form 425 AXLE AUTHORIZATION

MONTH MARCH MONTH APRIL

TYPE	CUSTOMER	SPEC.	ACTUAL Sched.	SALES Authorization	FACTORY Authorization	ACTUAL Sched.	SALES Authorization	FACTORY Authorization	
12 Ton	"N" Company	X-1	6	6	6				

POSTED TO FORM 603

each time a physical count is made, which shows the physical count and the bin count. These reports serve as an indication of how accurately these perpetual inventory records are being maintained.

Quite frequently we are called upon to assemble and deliver certain types of axles on a day's notice. This can be done where we have the material in stock, but in cases where we have to start from scratch the average time required to produce an axle would probably be from four to six weeks, depending upon delivery of steel, etc.

Release Authorizations and the Axle Material Schedule

As release memos are received by the material department from the sales department they are accumulated on what we call Form 425, "Axle Authorization." You will note that this form is merely a summation of releases received by our sales department during the month. It shows the type of axle, the name of customer and the number of axles authorized to be built. This information is then transferred to what we call our "Material Schedule," Form 603.

On this form, which is made out by axle type and customer, we list the month the axle is scheduled to be built and the actual date on which the building is completed. This form is the controlling factor of the material required for any one type of axle or axle specification and furnishes a yearly picture of what has happened to that axle or specification by months.

Use of the Material Schedule

Sales information is entered under the term "Contracts" on the left hand side of the form and this information is cumulative as new orders are received. Monthly and quarterly estimates are made by the sales and material departments and are entered in the "Scheduled" column as follows:

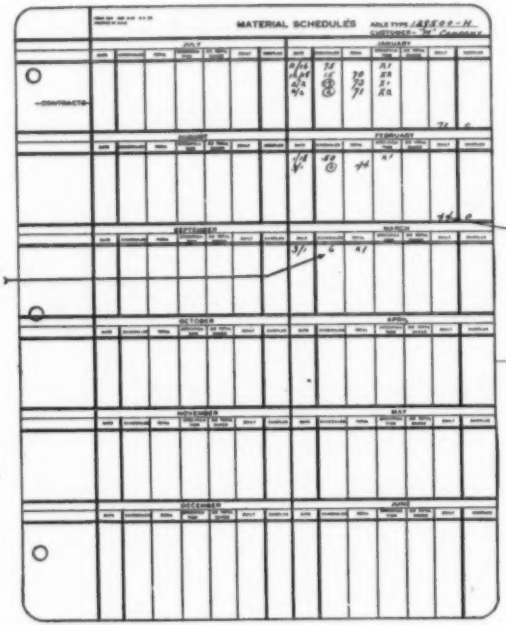
January	50
February	75
March	75
etc.	

All material ordered and scheduled is governed by this information. A daily building record of axles built is kept on the reverse

MATERIAL SCHEDULE

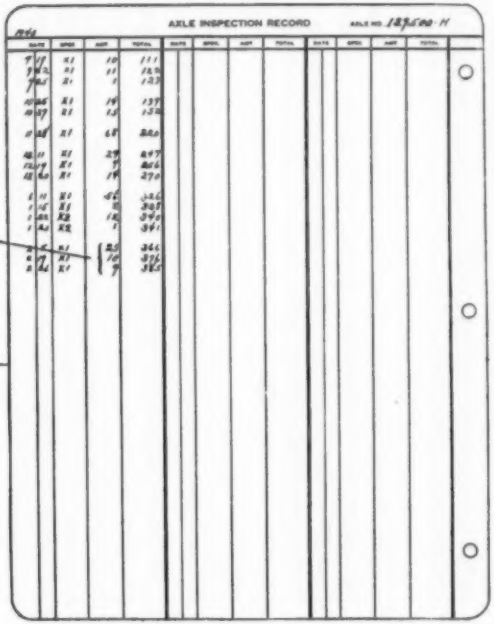
FORM 603

(FRONT)



96 POSTED FROM FORM 425

(REVERSE)



side of this form under the heading "Axle Inspection Record," and the monthly total is carried to the front side of the form and is entered under column headed "Built." If fifty axles are scheduled during the month and only forty are built, a surplus of ten is left and this is entered in the column headed "Surplus." This surplus of ten with the quantity scheduled for the following month would total the material available for that month.

The scheduled quantities are estimates made in advance by the sales and production departments and reflect tentative customers' requirements. If the actual building release we eventually receive from the customer differs from the estimate, then additions or deductions are made in the scheduled column and material requirements are adjusted accordingly.

This form, as previously stated, is a master record of the material department and furnishes a complete picture of the movement of material for any one axle, or specification, for a period of one year by months, and a glance at any time enables us to know the status of the material for that axle or specification. As a general rule, we build axles only as orders are received, although on certain basic standard axles advance estimates are made by the sales department and reasonable quantities of standard assemblies entering into the production of these axles are built in advance.

The Schedule and Requirements Record

The material schedule, Form No. 603, as previously stated, forms the basis of determining what our production and machining schedule is to be. To this, of course, must be added estimated requirements on standard axle parts, service requirements, etc. These requirements are then broken down into individual parts and posted on the schedule and requirement record, Form No. 242, previously commented upon. Shortages are then determined and the material department issues material requisitions for those parts of which we do not have a sufficient quantity on hand. These requisitions are then turned over to the purchasing department with instructions as to the date on which the material is required. It then becomes the duty of the purchase follow-up department to assemble these various requisitions and advise the material and planning departments as to whether or not the material can be brought to the plant in time to meet production schedules. This

is accomplished mainly by production meetings held each day at which representatives from the material, production and purchase follow-up departments discuss the problems involved in meeting the schedules.

Following Up on Deliveries

Frequently delivery promises obtained are not satisfactory and it then becomes necessary for the follow-up department to accelerate delivery dates promised by our vendors. In so far as is possible every effort is made to schedule the incoming material so that it will be received and delivered directly to the department on the date that it is required. This, of course, is necessary to eliminate unnecessary storing and handling of material.

To facilitate the issuing of purchase requisitions, we use Form No. 1011, "Master Productive Purchase Requisition." The quantity to be ordered is filled in by the material department and the card is then given to the purchasing department to insert the date ordered and the order number, after which the card is returned to the material department and serves to inform them that the ma-

MASTER PRODUCTIVE PURCHASE REQUISITION

FORM 1011

MASTER PRODUCTIVE PURCHASE REQUISITION C 13530

PART NUMBER 3400-C-419 PART NAME AXLE CENTER B. P. NO.

MATERIAL 1040 STEEL CLASSIFICATION 631

DIMENSIONS MAKES

MODEL 127500 H

REMARKS 3400 K 419 Dash ISSUED

PURCHASING DEPARTMENT RECORD

DATE	QUANTITY	VENDOR	ORDER NO.	PRICE	TERMS	DELY REQ'D
7/15/40	400	Plant #2	C27			

terial has been ordered. Information is also furnished to the purchasing and follow-up departments as to just when material will be required.

Scheduling Own Production of Parts

Up to this point we have covered in a general manner the material requirements to be obtained from the outside by purchases. Let us now turn to the parts which require machining and assembling in our own plant. The material department advises our planning department of the production requirements on parts which have to be machined in our plant and the axles which are to be assembled. This information is recorded on "Special Parts Record," Form 165. Referring to this specimen form, you will note that a card is made out for each part number requiring machining operations in the shop and shows the rough part number from which the finished part is to be developed. The figures

SPECIAL PARTS RECORD

FORM 165

ROUGH PART NO. 3400-C-419 | PART NAME Axle Center — Special Parts Record | PROD. MAX. ____ MIN. ____ | DEPT. MAX. ____ MIN. ____ | FINISHED PART NO. 3400-E 422

TYPE	MIN. ORD.	FORM 165	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
A750CA	1	ACTUAL REQUIREMENT PRODUCTION							50					
		ACTUAL REQUIREMENT SERVICE												
		BAL. DUE W/SC. OPEN ORDERS												
		W/SC. SCHEDULE												
		FINISHED STOCK INVENTORY												
		10												
		10												
		FACTORY SCHEDULE							50					
		BALANCE ON HAND												

POSTED TO FORM 30

across the top of the form represent the departments in which machining work will be required. Spaces are also provided for production and service requirements, for the inventory on hand, and for the quantities necessary for the factory schedule leaving the free balance on hand. When all necessary information has been entered on the factory machining schedule cards, machining schedules are then written up for each department. These schedules are turned over to our factory schedule clerks for entering on the "Departmental Factory Schedule," Form No. 30, in the column headed "Amount Scheduled."

The Departmental Factory Schedule

This departmental factory schedule also provides columns to record additions and removals from the schedule during the month. During the month, the daily production of machined parts is recorded by days and at the end of the month totals are deducted on the left hand side of the card in the column headed "Finished Stock," and the balance remaining is shown in the column headed "To Produce."

In those cases where there is not sufficient material in a department to take care of the quantity to be machined, it becomes the schedule clerk's duty to find out where the rough material is located and when it will be available. The schedule clerk, or stock chaser, as some of you may prefer to call him, must plan the work so that the foreman of the machining department will have sufficient parts on hand to complete a month's schedule in one setup, wherever possible. Where it is not possible to wait until all rough stock is available, plans must be laid to get as many pieces in the run as is possible. This is done to reduce the piece price and setup costs to as low a figure as possible. Constant surveillance must always be maintained by our planning and stock chasing departments to maintain a proper flow of material through the shop to insure all parts arriving at the assembly lines as originally scheduled. The machining schedule must be watched very closely every day, as it is subject to change from day to day due to additions and removals. It would be very easy to over-run on a part that had a removal if we did not check the factory schedule constantly.

FACTORY SCHEDULE

FORM 30

FACTORY SCHEDULE

ROUGH PART NO. 3400-C-419 PART NAME AXLE CENTER FINISHED PART NO. 3400-E422

POSTED FROM FORM 165

ANT. ORDERED	ADD	RDBK.	P.O.	TO PRODUCE	JULY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
50				50	DAILY PROD.				50																												
					TOTAL PROD.				50																												
					TOTAL SCRAP																																
					R. S. REC'D		50																														
ROUGH STOCK ORDERED 191					TOTAL REC'D		50			50																											
					BAL. IN PROD.					0																											

ANT. ORDERED	ADD	RDBK.	P.O.	TO PRODUCE	AUGUST	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
					DAILY PROD.																																
					TOTAL PROD.																																
					TOTAL SCRAP																																
					R. S. REC'D																																
ROUGH STOCK ORDERED 191					TOTAL REC'D																																
					BAL. IN PROD.																																

ANT. ORDERED	ADD	RDBK.	P.O.	TO PRODUCE	SEPTEMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
					DAILY PROD.																																
					TOTAL PROD.																																
					TOTAL SCRAP																																
					R. S. REC'D																																
ROUGH STOCK ORDERED 191					TOTAL REC'D																																
					BAL. IN PROD.																																

ANT. ORDERED	ADD	RDBK.	P.O.	TO PRODUCE	DECEMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
					DAILY PROD.																																
					TOTAL PROD.																																
					TOTAL SCRAP																																
					R. S. REC'D																																
ROUGH STOCK ORDERED 191					TOTAL REC'D																																
					BAL. IN PROD.																																

Following Production Through the Plant

In any plan of production control, the control of the flow of parts through the factory from raw material stores to finished parts is a big and important problem. The following of each order sent in to the factory to see that the material is kept moving and calling to the attention of the department foreman and the general foreman any irregularities which may occur falls on our schedule clerks, or as you may prefer to call them, stock chasers. They are responsible for keeping the assembly departments provided with an ample supply of all parts when needed, so that delays will be reduced to a minimum. I think you will all agree one of the greatest causes of delay in production of any finished article, and for abnormally high cost in assembling, is the retardation of assembling due to lack of parts when needed.

There is no question at all that the amount of time lost due to lack of the proper flow of material to the operator is extremely serious. A constant flow of material tends to produce a greater amount of efficiency in the workers throughout the shop. Our stock chasers are required to keep the foremen in the various departments constantly notified upon which stock, and what parts, work should be performed. A foreman may have four or five hundred different parts to machine, and if he is left without guidance, he may select a number of parts to work on with which the stock rooms are amply supplied, while he could be working on parts on which shortages are developing.

Duties of Foremen and Stock Chasers

Before a foreman gives out a job to an operator, we require that he check the machining schedule to see whether or not any changes have occurred in the schedule during the course of the day. The foreman must also keep posted as to the rough stock in the department and he and the schedule clerk must be certain at all times that there is enough stock to finish the job or lot.

As previously stated, the machining schedule is planned to take full advantage of long runs and save in the amount of setups, preventing excessive production costs. Whenever a job is given out to an operator, the foreman and the operator first review the blueprint covering the job. The foreman then checks the tool routing sheets for the operation and the proper setup of tools,

such as jigs, fixtures, etc. After the job has been set up, the operator is required to take the first piece machined to the foreman and inspector for approval. If O.K.'d the operator obtains a piece-work ticket from the timekeeper and from that time on is paid for the number of pieces produced. At the end of each day the foreman is required to check the time tickets and O.K. them for any day work or irregularities from regular standards.

The first thing each morning the foremen and stock chasers in our assembly departments get together and make a check of the material in the assembly departments and compare this with their building schedule for the next few days. In making this check a building stock shortage is arrived at. These stock shortages are written in duplicate and one copy is sent to the general foreman for discussion at what we call the general production conference which is held each morning in the general superintendent's office where "hot" shortages and other production problems are discussed. This daily conference is attended by representatives of the production department, planning department, follow-up department, stock chasers, inspection department and tool department. Those in attendance at this meeting are jokingly referred to as being in the "hot" seats. I am told you have to be "good" to occupy one of these seats, that is, a good promiser.

Control of Scrap

All scrap made in the shop must be checked with the salvage and control man each day and all scrap tickets must be signed by the foreman. After signing the scrap tickets the foreman is required to post on a scrap board we maintain in each department the amount of scrap made that day. This board is placed in a conspicuous place in the department so that all operators will see what has happened to good material. On this black board is posted the amount of scrap, the part number, name of part and the cost of material and labor lost due to careless work. The posting of scrap on this board by the foreman keeps him in constant touch with careless operators and the amount of goods that goes into the scrap pile. We have found that the use of this scrap board has a psychological effect on the operators and has gone a long way towards reducing scrap caused by carelessness.

In providing material for our service requirements, careful con-

sideration is given to past performance and particular usage, as certain parts are less liable to replacement than others. We usually try to provide for our service requirements on the original purchase of the production material so as to get it in the original production run and avoid excessive cost of small service runs later on. Consideration is also given in planning the production run so that allowance is made for a nominal amount of scrap and any other shrinkages we might encounter in production.

Slow Moving and Obsolete Stock

The uncertainty of changes in design in commercial vehicles, discontinuance of models, etc., raises the question of obsolescence and naturally this has to be carefully guarded against. This is accomplished by periodic surveys of our perpetual inventory records to determine slow-moving items. Periodic reports are rendered by our material department covering slow-moving and obsolete material and the records covering this material are then segregated so that they are constantly before us. As soon as an item is placed on a slow-moving or obsolete list, studies are immediately made to determine whether or not the part can be reworked to some other part or whether it should be disposed of at scrap value. Our material department furnishes the management periodically with reports showing the cost and scrap value of any material which is sold as scrap as well as similar information on items previously eliminated from the inventories which may have been reworked into other parts or sold as service parts.

Control of Indirect Expense

For some years we have set up "bogeys" in our various plants which represent the amount of expense per productive hour allotted to each plant for certain items, which we consider controllable by the shop supervisory force. These expenses include such items as indirect labor, supplies, maintenance, power, heat and light, and scrap. The indirect labor, in turn, is broken down to direct departments, material handling, inspection, tool crib, time and tabulating, and miscellaneous shop orders. These figures are taken each month and the labor rates for the various plants are all adjusted to the labor rates in our Detroit plants so that an equit-

able comparison can be made by plants of these expenses. We also conduct a contest between our various plants as to which plants beat their own bogey by the best percentages each month. We have found this idea to have been well received by our supervisory force and it has saved us a considerable amount of money in keeping these so-called controllable expenses to a minimum.

Control of Indirect Labor

We also prepare daily reports showing the ratio of indirect to direct labor hours in the various departments of our business. Each morning we prepare a report for the preceding day and we have found these reports to be extremely helpful in controlling indirect labor costs in the various departments. We have established certain percentages based upon past experience for each department, which are used as a bogey and with which the actual indirect labor hours are compared from day to day. This information is prepared in a report which shows the productive and indirect hours in each department for each day compared with the same working day in the previous month. The same information is shown for the accumulated current month to date compared with the same period last month. A comparison is also made showing the number of hours over or under the bogey established for each department. In addition we show historical information for the preceding three months. Copies of these daily reports are received by the management and are also given to the shop superintendent and general foremen for discussion at their daily meetings. The cost of preparing this information daily is a small item when we consider the control established over these items of our production costs.

I have given you a general outline of the more important phases of our production and inventory control methods and have furnished you with a few specimen forms of some of the records we use. In closing I might say we are continually on the lookout for different methods of improving our inventory and production control and we do not hesitate to make changes where improvements can be made.

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